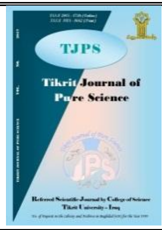
TJPS

TIKRIT JOURNAL OF PURE SCIENCE

Journal Homepage: http://main.tu-jo.com/ojs/index.php/TJPS/index



Geometric Investigation of Al-Wind Dam Reservoir Northeastern Iraq, using Digital Elevation Models and Spatial Analyses System

Sabbar A. Saleh , Iktifaa T. Abdul Qadir , Amin M. Ibrahim, Huda M. Hussain
Department of Applied Geology, College of Science, University of Tikrit, Tikrit, Iraq

DOI: http://dx.doi.org/10.25130/tjps.23.2018.051

ARTICLE INFO.

Article history:
-Received: 15 / 1 / 2018
-Accepted: 22 / 1 / 2018
-Available online: / / 2018

Keywords: Al-Wind Dam, DEM, NPA

Corresponding Author:

Name: Sabbar A. Saleh
E-mail: sabbar.saleh@gmail.com

Tel: 009647701726315

Affiliation:

Abstract

Geometric analysis of Al-Wind dam reservoir in Diyala discussed in this paper as necessary and strategic subject, spatial analysis systems were used to extract the area of Al-Wind dam reservoir from the digital elevations model (DEM), at 26 selected water levels in the reservoir with one meter interval, from 195 up to 219.5 m.a.s.l., the geometric criteria used to extract the essential negative geometric elements represented by the Negative Volume (NV) Negative Planner Area (NPA) and Negative Surface Area (NSA), the perimeter of water body, the depth of water column and the shape factor of the reservoir, as well as for the positive geometric elements as Positive Volume (PV), Positive Planner Area (PPA) and Positive Surface Area (PSA) of the islands within the perimeter of the reservoir.

The elements above are basics in geometric studies, which are used to design the procedure of reservoir operating, as the control on storage, and releases from the gates of the dam in the different operating conditions, it is control the changes that will occur on the land uses after beginning the storage at each level, as well as the changing on the outcrops of geological formations that would be inundated with changing in water level, accordingly, the secure operation level were determine to avoid the hazards on the dam, and decrease the wastage in the land use and the stored water, and decrease the immersed areas, the mathematical relationship between the inundated areas and the capacity of the reservoir were derived to use it in the future for the operation and routing of the reservoirs, determine the surface area of the reservoir as well as predict the capacity of the reservoir at each level.

The current analysis reflect that the maximum operational safe level is 215 m.a.s.l., that equivalent to the capacity of 54,308,822 m^3, while the preliminary study of the dam, which was conducted using conventional methods to the survey indicated that the storage capacity at the same level is 37,820,000 m^3.

Digital elevations models for each selected level was exported as digital images of same scale for the purpose of visual comparison between the extensions and forms of the reservoir at different levels.

This analysis useful to management of the dam used by the administration of the dam in the selection of suitable operational policy for the reservoir.

Introduction

The crisis in Iraq and the decline of Iraq's share of water by aggravation the problem of drought in all areas of Iraq and the world, it is characterized by its occurrence in the arid and semi-arid regions with hot summer and relatively cold winter, the temperature varies significantly and rainfall rates from the far south to the north, which in recent years significant decline in their know rates, as well as the lack of Iraq's share of the water obtained from the rivers shared with Turkey, Syria and Iran, because of the control and storage projects established and assessed by these countries [1], all calls for thinking rational way to manage water resources, and to know that dams is one of the most important solutions for the regulation and rationalization these resources.

The project Al-wind dam is the strategic project in the city of khanaqin in northeaster Iraq and classified this dam within the middle dams and completed this dam by Iraqi hands company and specifications world of dams, and considered the first dam in Iraq and the Middle East was implemented using a plastic barrier to reduce the seepage under the dam.

In order, the geometric elements of the reservoir and analyze spatial variables of geomorphological phenomena at selected levels of the reservoir, and analysis of the relations of geometric elements such as storage volume, planner area of water body, wetted area and depth of the water column at different locations of the reservoir and contraindication of the reservoir, and to know the changes that occur on the uses of the surrounding lands at each level, and determine the relationship between discharge of the river and the capacity of the lake, in order to reach the differentiation between the different levels to choose the optimum one.

Traditional topographical surveys are usually used for these investigations, which is usually limited to the volume of the storage. In this case, the results are often in accurate due to lack of survey points and topographical complexity.

The use of digital elevation models has made a big jump in dams reservoirs studies, because of the facilities and accuracy that can be obtained due to the large number of survey points relative to the traditional land survey, the digital elevation models was adopted in the derivation of the reservoir area at (26) selected level, where the methodology included several steps and used software packages specialized in GIS and remote sensing.

The study area is located in northeastern Iraq on the Wind River in Diyala province, 7Km southeast of Khanaqin city and 6 Km from the Iraqi – Iranian border. The study area is shown in figure (1). By the coordinates of the dam body are determine by two points as in table (1).

Table (1) represents the coordinates of the study located (dam body)

Point	Easting	Northing
A	540940	3797320
B	540613	3796029
UTM Zone 38 DATUM=WGS84		

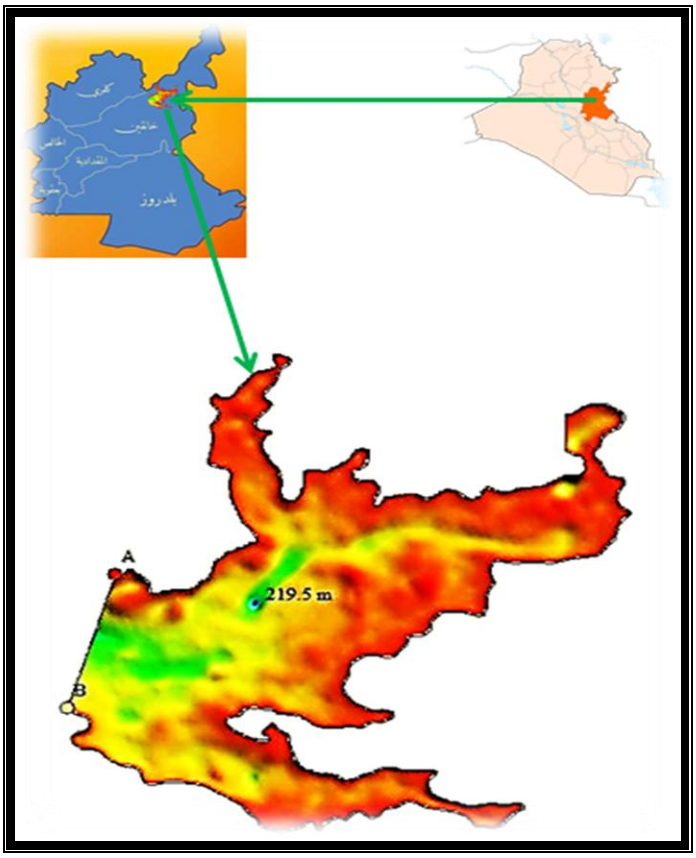


Figure (1) location of the Al-wind dam reservoir within boundaries of Diyala/ Iraq at the level 219.5 m above of sea level

Geology of the Study Area:

The reservoir is flooded different geological formation outcrops at different levels, so it is of stratigraphic importance in the region; the differences of geological formations that have been submerged with the beginning of storage are Mokdadiya formation (Upper Miocene-Pliocene) which is one of the oldest geological Formations in the region, as shown in the geological map figure (2).

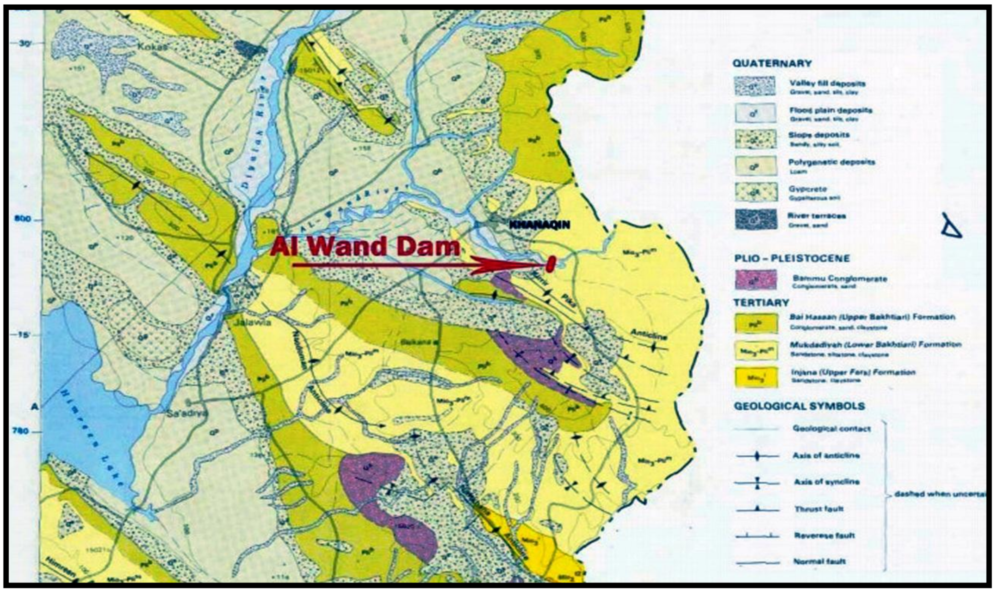
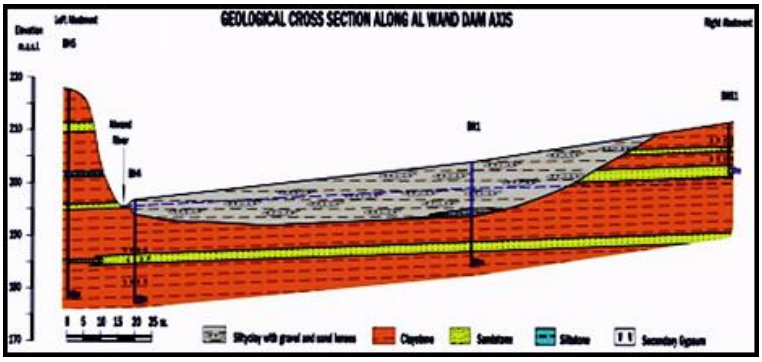


Figure (2) Geological map of the studied area

The investigation consist of sequence of claystone, sandstone and limestone, which contains varying proportions of gravel, these sediments are located on the banks of the original river, sometimes covered with recent sediments and sediments of the quaternary period, sometimes interspersed with secondary gypsum sediments. As in the geological cross section, fig (3).



Fig(3) Geological cross section along the axis of the dam

The outcrops of Al-Mokdadiya Formation in the area of the reservoir cover the oldest sediments represented by the layers of Injana Formation (Upper Miocene- Lower Miocene). As in the right bank of the river, there are Quaternary sediments represented by the river terraces, which consist of the siltstone that is interspersed with lenses of gravel and sand, also polygenetic deposits of Quaternary sediments present on the right bank of the river. There are recent sediments filled the depressions in study area, and inconsistent sediments in the narrow flood plain that does not exceed tens meters along the course of the river, these deposits are submerged at the beginning of the storage and after submersion of flood plains.

The structural elements in the area are that the anticline surrounded the reservoir from the south, and the thrust fault extends along the fold towards south-west, this fold is one of the determinants of the extension and shape of the reservoir [2].

Geomorphologically, the reservoir area contains a group of geomorphological features that give the final shape of the reservoir and its extension. The study area is located in the eastern part of the transition zone between the foot hills and the high folded zones. Topographically the elevation of the area ranges between 195m above sea level near the site of the dam, to 220m above sea level, which represents the highest rise in the outer perimeter of the reservoir, in some depressions within the lake may be less than 195, representing the pool as a part of the dead storage. When the drainage system is derived from the digital elevation model of the reservoir (before storage), notice the presence of longitudinal and transverse valleys, which intersect the site and form a drainage pattern as shown in Figure (4), these valleys especially the transverse ones, appear as bays after the storage.

The area of the reservoir is divided into two parts by a geological barrier; these parts are then connected near the body of the dam, as shown in 3D model of the water reservoir Figure (5), each part of the reservoir is interspersed by barriers separating the transverse valley.

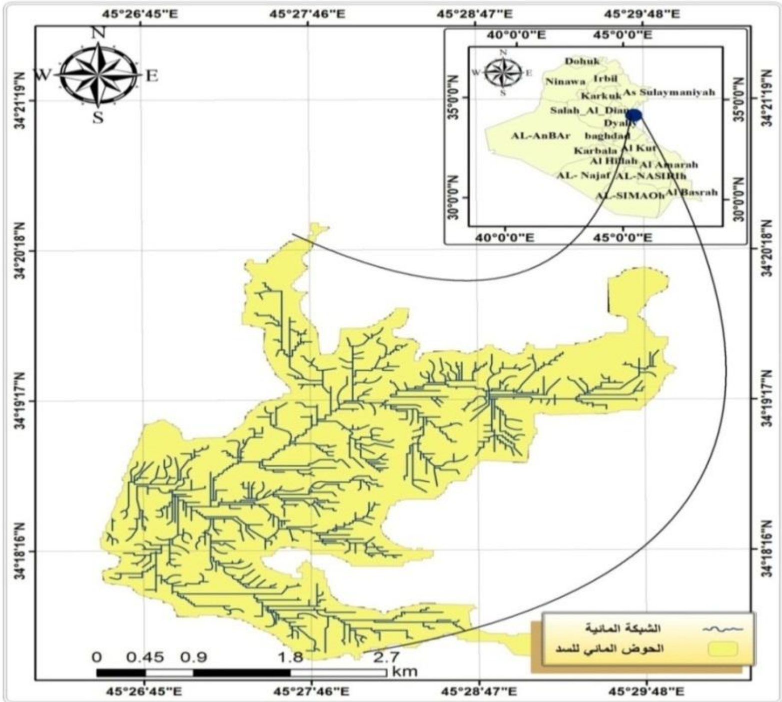


Figure (4) Drainage system of the reservoir at level 219.5 m

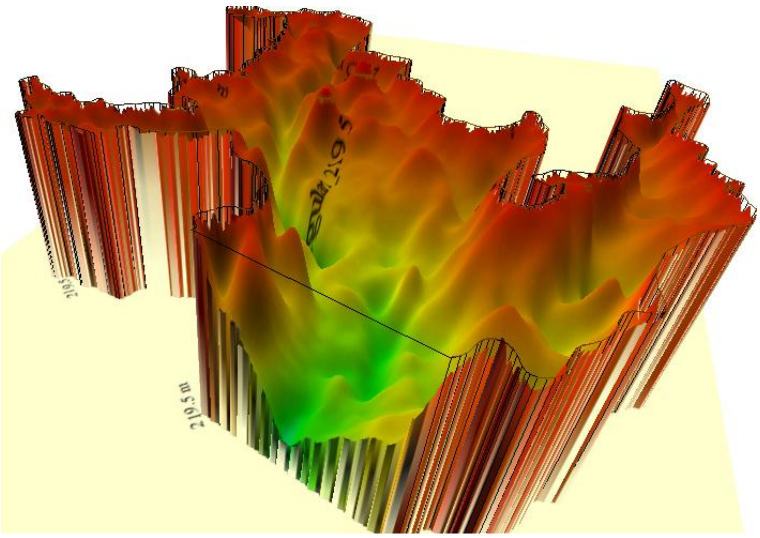


Figure (5) 3D model of the wind dam reservoir (high exaggeration factor used to explain the shape of the reservoir)

Materials and method

1- The digital elevation models with resolution 23*23m was called by Global Mapper V.13, then the digital model of the reservoir was seperated at (26) elected level, from (195)m to the top of the dam (219.5)m, and was exported as (Global Mapper package file) as shown in Figure (6).

2- Locate the two ends of the dam in the field as well as the deviation in the body them on the digital elevation model, represented in point (A), the beginning of the dam from the right, and (TP) is a deviation point in the dam body, and (B) the end of the dam from the left, as in the table (2):

Table (2) the coordinates of study site

Name	Easting	Northing
A	540940	3797320
B	540613	3796029
TP	540664	3796564
UTM Zone 38 DATUM=WGS84		

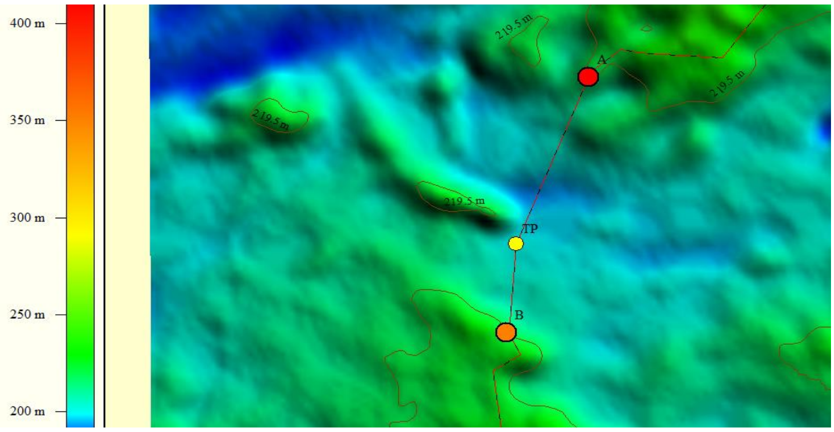


Figure (6): The coordinates of the points on the digital elevation model

3- Generate the contour line, which represents the height of (219.5)m above the sea level, and cut the limits of this line east of the body of the dam along the course of Al-Wind river, the line represent the highest level of the reservoir in emergency conditions, as shown in the figure (7).

4- generate the contour lines for the earth surface elevations for each hypothetical level to extract the DEM for these levels, to determine the values of geometric elements, the contour interval (1m) used for the levels from the lowest (195m), to highest (219m) as shown in figure(8).

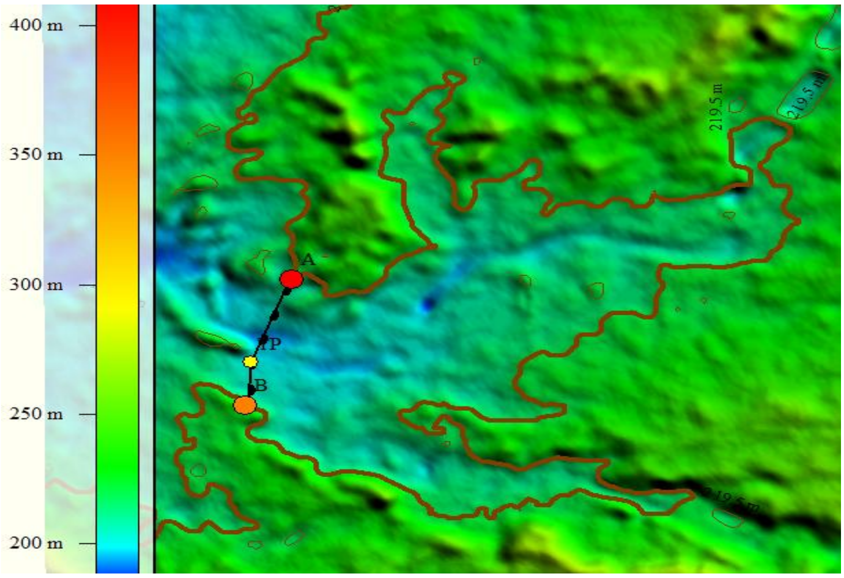


Figure (7) the contour line, which represents the height of (219.5)m a bove of the sea level

1- The digital elevation data was re-isolated using Digitizing tool of Global Mapper 13, at each contour line of (26) elected levels.

2- Digital elevation model for each level was saved in a Global Mapper Package File, and then requisition the data again to the program (Global Mapper), to draw the topographic sections of reservoir by (path profile/ LOS- line of sight).

3- Digital elevation data for each level was exported to a JPG image file for visual comparison.

4- The software (SURFER) used to extract the geometric elements, where the extracted digital elevation models exported by Global Mapper as (Surfer Grid File) to process the resulting file with (Surfer13) (Global Software, Inc., 2013), to calculate the geometric elements (volumetric, spatial and longitudinal data) the (Grid- volume) command adopted for this purpose, each of these files is used to define the values of the bottom of the reservoir at the selected level. The file name is entered in the upper surface field, while the hypothetical water surface of the reservoir at the concerned level is inserted into the lower surface field in the dialog box as in figure (9):

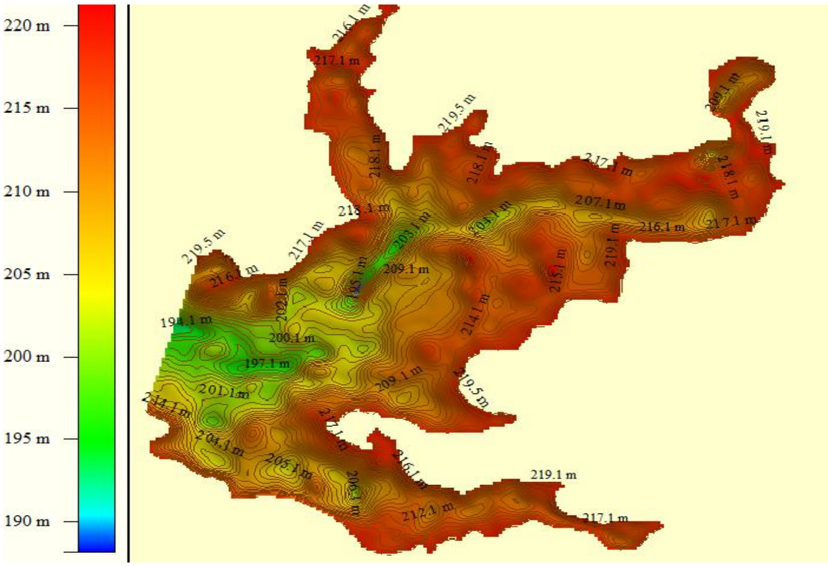


Figure (8) contour lines for the earth surface high level

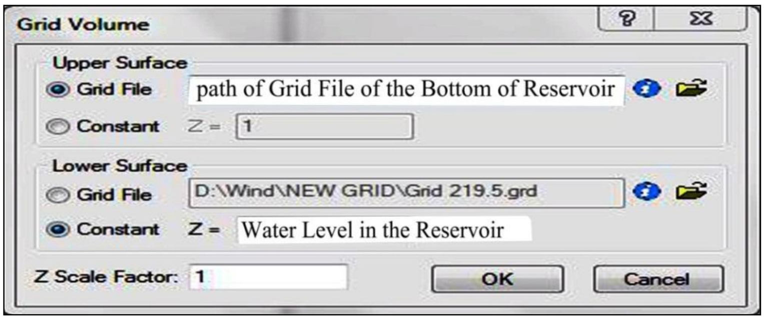


Figure (9) the dialog box (Grid- volume) to illustrate the upper and lower surface

The command above executed and the report of geometrical calculation issued and includes:

1. Positive Surface Area, (PSA)
2. Negative Surface Area, (NSA)
3. Positive Planner Area, (PPA)
4. Negative Planner Area, (NPA)
5. Negative Volume, (NV)
6. Positive Volume, (PV)

Result

The positive surface area that represents the uneven area of the islands within the boundaries of the reservoir, and negative surface area represents the uneven wetted surface of the bottom of the reservoir, while the negative volume represents the volume between the bottom of the reservoir and water surface, and the positive volume represents the volume of the islands within the perimeter of reservoir at concerned level, fig (10).

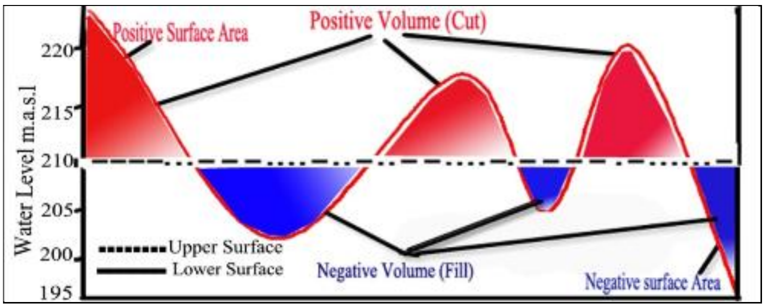


Figure (10) the concept of positive volume, positive surface area, negative volume, negative

surface area and upper and lower surface when water surface is (210m) above sea level.

The planner area are calculated after the projection of positive and negative surface area on the horizontal level and calculating the area of the projection, the positive planner area represents the flat area of the islands inside the reservoir, while the negative planner area represents the flat area of the water body, fig (11):

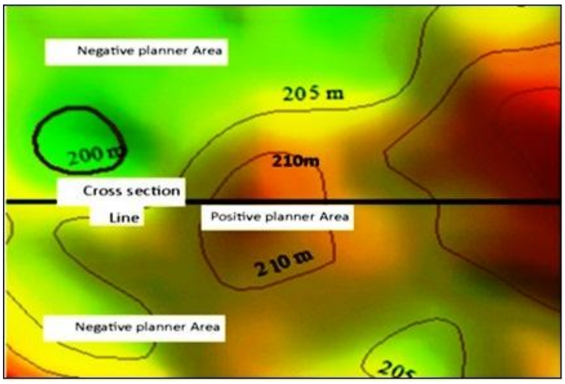


Fig (11) planner Geometric elements

Digital elevation models exported as Global Mapper Package files at each level, and re-exported as surface elevation Grid file, the processing report includes the values of the geometric elements (PV, NV, PSA, NSA, PPA, NPA) corresponding to the selected levels, the values of these elements are tabulated in the table (3).

(Arc. GIS- 93) usrd to call all image layers of the levels for final reorganization. And export them as JPG files of standard scale for objective visual comparison between the horizontal extensions of the reservoir and the reservoir area at each level, as in figure (12).

Table (3) Geometric elements at each level in metric units extracted from grid files SURFER

Level m.a.s.l (m)	**Positive Volume** (m^3)	**Negative Volume** (m^3)	**Additional Volume** (m^3)	**Total Volume** (m^3)	**Positive Planner Area** (m^2)	**Negative Planner Area** (m^2)	**Positive Surface Area** (m^2)	**Negative Surface Area** (m^2)
195	0	28354	11451	39805	0	16390	0	16393
196	0	71284	20578	91862	0	35513	0	35526
197	0	130764	33033	163797	0	62051	0	62076
198	0	476295	51389	527684	0	239620	0	239704
199	11	830649	74713	905362	1	341477	1	341608
200	5230	1283274	101926	1385200	11514	486459	11517	486653
201	60	1911724	133881	2045605	137	627403	137	627657
202	1562	2765028	173068	2938096	6204	832467	6205	832797
203	19	3795990	215823	4011813	1	1051752	1	1052163
204	55	6524954	262306	6787260	3	1557139	3	1558299
205	132	8384041	313312	8697353	91	1905944	91	1907334
206	23279	10611394	366037	10977431	35624	2195110	35639	2196705
207	3479	13521961	419150	13941111	6936	2536007	6940	2537911
208	177	16309763	472723	16782486	347	2776752	347	2778939
209	8304	20371933	526663	20898596	17833	3453542	17837	3456217
210	75637	24315097	581089	24896186	57749	3959601	57779	3962657
211	31883	29032375	635514	29667889	32054	4546492	32069	4550053
212	13052	34181126	689939	34871065	21919	5030795	21929	5034875
213	11357	39773494	744365	40517859	14594	5575901	14609	5580536
214	2604	46221321	798790	47020111	5007	6319569	5012	6324799
215	212719	53455606	853216	54308822	164955	7156739	165063	7162602
216	355872	61467776	907641	62375417	260025	8001028	260174	8007668
217	170775	70959099	962066	71921165	120896	9076785	120992	9084518
218	130061	80806158	1016492	81822650	128179	9880465	128250	9888856
219	43024	92962464	1070917	94033381	51202	10960804	51233	10970701
219.5	25745	98543543	1098130	99641673	31672	11326496	31692	11336771

Calculating the volume of the storage

The basic method to extract the digital elevation model at each level is the automatic method in which the area is isolated after the conversion of the contour line which represents a line feature to areal feature which surrounded the isolated area. Since the body of the dam was not straight the calculating of the volume of the reservoir was carried out in two stages:

The first stage uses the automated method that depends on closing the contour line as areal feature, and then exports it as in the steps of methodology.

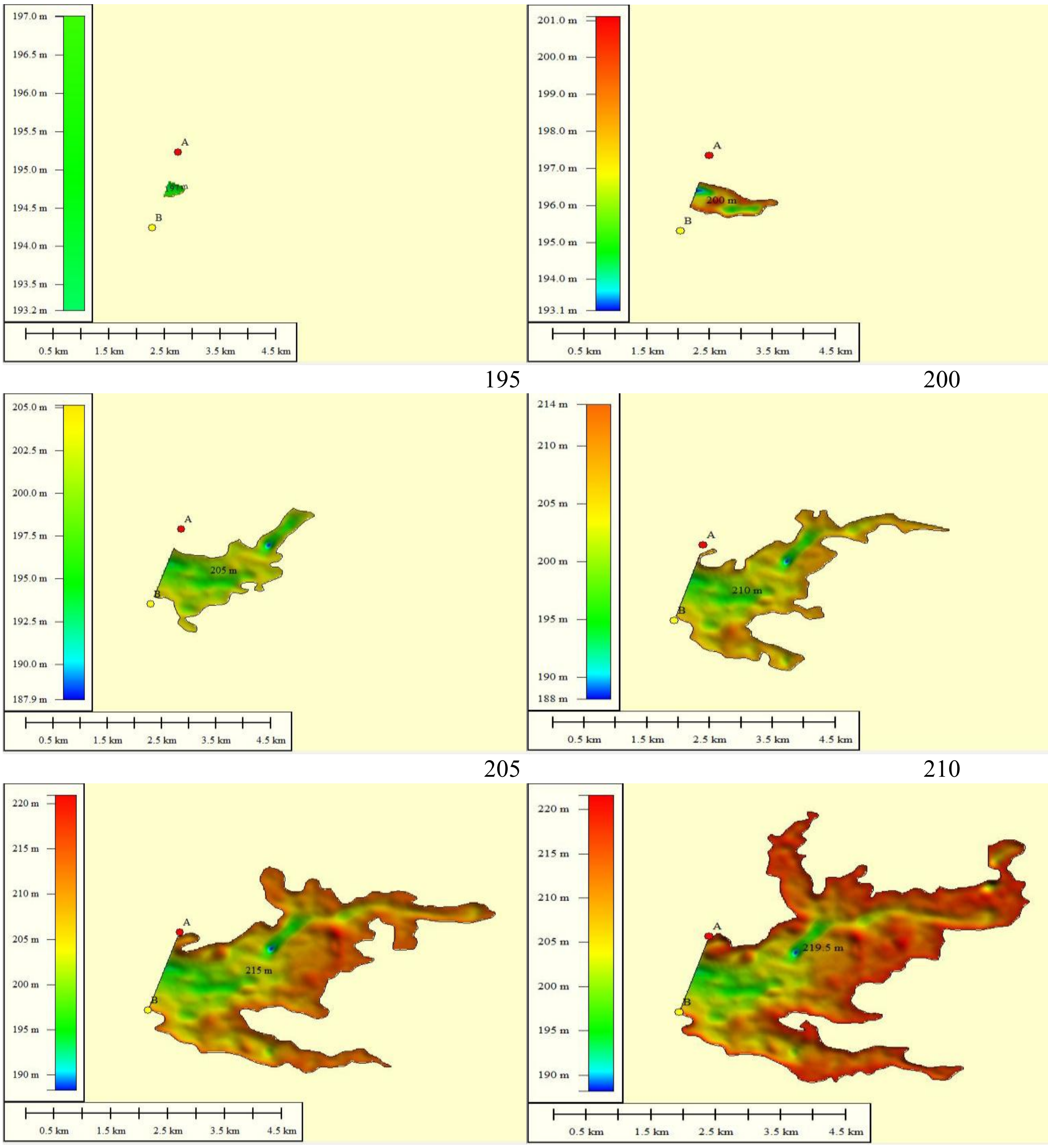
In the second stage the triangle (A),(TP), (B). adjacent to the dam body was manually extracted from digital elevation models at each level, as shown in fig (13), and export this part to (Grid file) and then calculate the volume in same steps of methodology to calculate this additional volume and insert its value in column 4 in table (3), and then add the volume of storage (negative volume) at each level to additional volume to find the total negative volume at each level.

Discussion:

The study of geometric elements represented by reservoir volume, surface area (evaporation area), the bottom of the reservoir (wet area), shape factor and depth of the water column, areas of islands and bays corresponding to each level of reservoir dam, that represent important information that depends to

ISSN: 1813 – 1662 (Print)
E-ISSN: 2415 – 1726 (On Line)

determine the optimum safe operating policy, that signifies a data base for designers to returned to when designing the dam and its structures, especially in the proposed new dams, it support a decision on the construction of the dam.



195 200

205 210

215 219.5

Fig. (12): The variation of the shape, area, and the extension of the reservoir with the selected levels of the reservoir

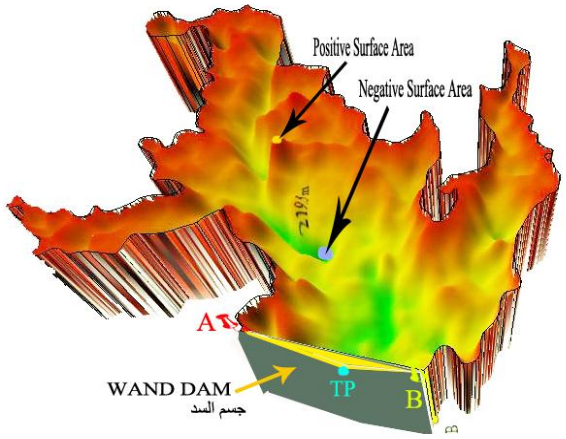


Fig (13) shape of reservoir is 3D and dam body section

The geometric analysis aims to illustrate the relationship between geometric elements with level of water in the reservoir and between these elements with others, and analysis the changes on land uses on each level.

The first relationship illustrate the changes of positive volume with the water level, the relationship shows the fluctuation of positive volume with increasing water level in general, especially at level (206, 210, 216, 217)m above sea level, and observe sharp increase at the levels (215m) and (216m) above sea level, accompanied by a decrease of volume at levels (217, 218)m above sea level, the cause of this extraordinary increase that appearance of new islands within the body of reservoir with the increase of levels, that led to additional areas, at last lead to increase the positive volume, this is an important determinant of future land uses, especially the areas of islands that will appear at these levels, which may be important in tourism uses as shown in fig (14).

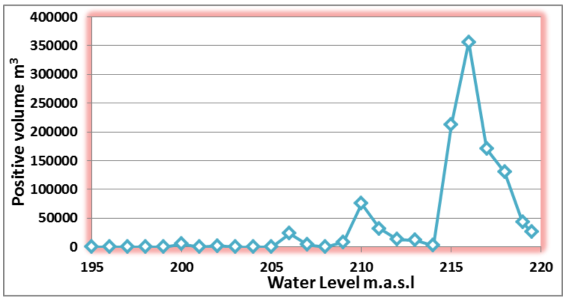


Fig (14) relationship between water level and positive volume

Either the second relationship between negative volume with water level that shown continuous increase in negative volume with water level, in general the direction of this relationship is divided into three stages separated by two transitional stages.

The first stage begin from the level (203)m above sea level, which has the capacity of the reservoir (2045605m^3), and ends at level (211m) above sea level, that has the capacity of the reservoir (29667889m^3) where low increase in the capacity of the reservoir, the second stage between the level of (211) m and the level (215m) above sea level, that corresponding to the capacity of reservoir (54308822m^3), where the increase gradually more accurate than the first stage. The final stage begins from the level (215m), to the level (219.5m) where the capacity of reservoir is about (99641673m^3). Where the increase in the negative volume is dramatically with the increase in the level and more sharply than the two previous stages, the transition from first stage to second is caused by the exit of the storage from the original river channel to the flood plain. While the transition from the second stage to final one because the exit of the storage from the flood plain to the river terraces, either the stage preceding the level (203m) represents the dead storage, fig. (15).

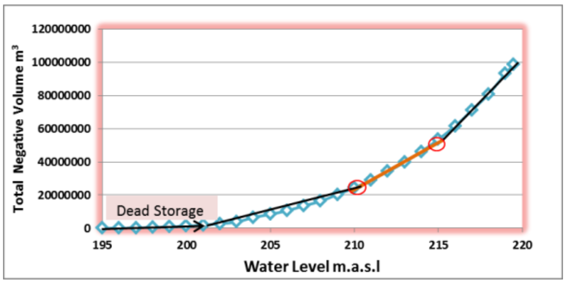


Fig (15) relationship between water level above of sea level and total negative volume on the vertical axis

The positive surface area which represents the uneven area of the islands, it is relatively low when the low levels below (205m) where the reservoir boundary is still within original stream channel (within the limits of the valley cliff), but this area increase immediately after this level and then begins to fluctuate due to the roughness of the valley banks. The increase of the volume of islands is due to the addition of new islands to the reservoir. So that the area of the islands as high as possible at the level of (216 m) as in fig (16).

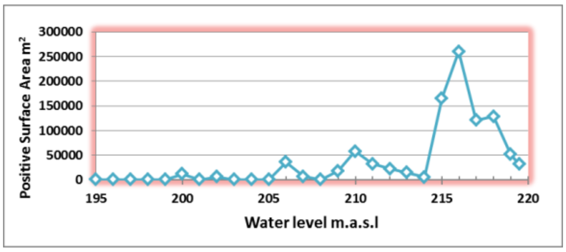


Fig. (16): The relationship between the water level and the positive surface area

The negative surface area represents the uneven surface of the wetted (submerged) area, it has low slight continuous increase in the low levels, but this relationship is greatly increase after level (198m) due to the exit of the body of the reservoir from the original channel cliff, as in figure (17).

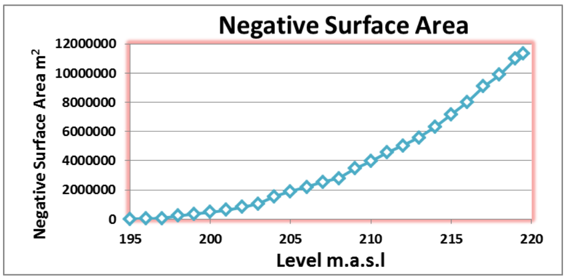


Fig.(17) the relationship between the water level and the submerged surface

The positive planner area which represents the flat area of islands have a similar behavior to the positive surface area, as they are relatively low in to the levels below (205 m), where the boundary of the reservoir is still within the original channel of the (within the limits of the valley cliff), but this area increase directly above this level, after which it fluctuates due to the roughness of the valley banks, the islands appear and disappear with the increase in the level due to the addition of new island to the body the reservoir, as in figure (18). The high similarly in the behavior of the positive surface area with the positive planner area is due to two reasons:

First: the low roughness of the topography, so that the flat area is roughly equal to the uneven area. However, the second reason is the low accuracy of the digital elevation model so that all topography less than the area of the cell unit (one pixel size in the digital model used 23*23 meters) disappears, so the undulated area is very close to the flat area, as in fig (18).

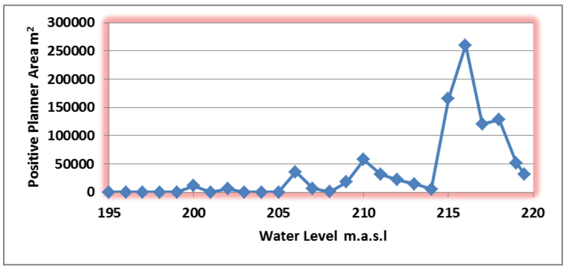


Fig. (18): the relationship between the water level and planner area of islands

The negative planner area which represents the flat area of water body have a similar behaves to the negative surface area, as their value increase continuously and does not fluctuate with increasing levels, the slope of the increasing curve is low in low levels, but the increase significantly mentioned above the level (198)m for the same reason mentioned in previous paragraph because the body of the reservoir exit out of the original valley cliff, the large symmetry of the negative surface area and negative planner surface is due to two reasons:

The first is the low roughness of the topography of the bottom, so that the flat area of water body is roughly equal to the uneven area of bottom. However, the second reason is the same reason that low accuracy of the digital elevation model so that all topography less than the area of the cell unit (one pixel size in the digital model used 23*23 meters) disappears, so the undulated bottom is very close to the flat area of water body, as in fig (19).

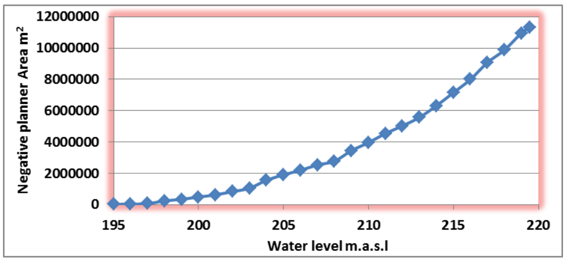


Fig. (19): The relationship between the water level and negative planner area

When comparing the variety of Negative Planner Area and the total negative volume, the increase in the flat area of water body (evaporation area) is relatively small compared to the large increase in storage volume, as in figure (20), its noticed that a relatively large increase in the volume of storage especially when this volume ($527684 m^3$) corresponding to level (198 m), as the increase after this level is relatively greater than before, as in figure (20), which turns out to be at the beginning of the figure, any increase in the volume of storage is a companied by a large increase in negative planner area. This means that the bottom of the reservoir in this area is of a planner nature.

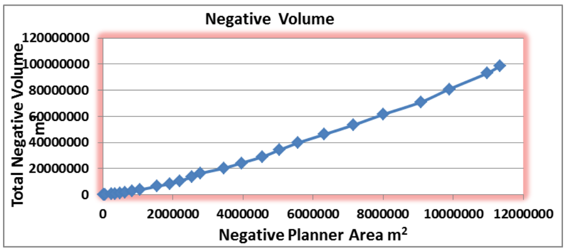


Fig. (20): The relationship between the negative planner area and total negative volume

Dead Storage:

It is defined as the volume of storage at the lower level of lower gate of the dam, at this level; at this level the storage cannot exist from the gates, and therefore metaphorically called dead storage. Which is under the level (203 m), as shown in the figure (25), as the lowest level of the gates of Al-Wind dam is (203 m), through the geometric analysis in the table (3), the volume the dead storage equal ($4011813 m^3$), dead storage usually reduced over time due to the accumulation of the deposits in the area below the level of gates, as shown as in the figure (21).

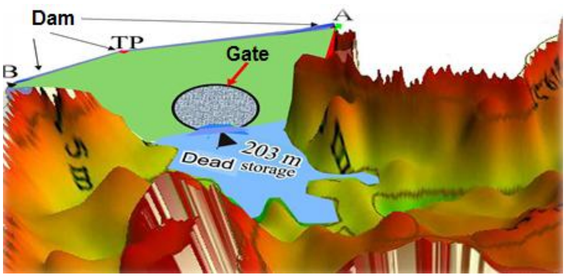


Fig. (21): Dead storage at the level (203 m)

The percentage of the dead storage (which reached to 54308822 m^3, at the operational level 215m) to total storage is (7.4%), which is acceptable for the total volume of the reservoir.

Conclusions

Through the geometric analysis results of number of important geometric elements of the reservoir, the following conclusions can be reached:

1- The innovated method of geometrical analysis in this study, that supported by the digital elevation models and spatial analysis system are an excellent, accurate and effective method, but its accuracy increased with the increasing of accuracy of digital elevation models.

2- The innovative method has developed a method of integration between the different spatial analysis software that exports the data to each other.

3- The relationship between the levels and the negative geometric elements, such as negative volume, negative planner area and negative surface area are non-linear covariant relations, in which there are more than one direction and transitional stage, these directions and stages are due to the increasing of storage and submerge areas, as a result of the exit of the reservoir from the original stream of the river to the flood plain, then from the flood plain to the river terraces.

4- The relationship between the levels and the positive geometric elements such as positive volume, positive surface area and positive planner area, is generally fluctuated relationship, if the increase of the level companied by the expansion of the reservoir to a new land with the appearance of new islands, the positive volume will increased, either if the raising of the level is not companied by appear of new island, the positive volume will be decrease as a result of the submerge of an islands gradually with the increasing of the level.

5- The increasing of the positive volume at a number of levels will has a great importance in determining the optimal use of these islands, especially for tourism.

6- The similarity in the behavior of positive planner and surface geometric relationships with the level reveal to that there are no topographic complexities, but this is probably due to the lack of accuracy of digital elevation models adopted in the analysis

Recommendations

1- Adopt the results of this geometric analysis in suggest the operation scenarios of the dam reservoir, that related to storage, release and control the storage.

2- Use the most accurate digital elevation models in the future studies of reservoirs, by the same procedure and methodology

3- Achieve studies of reality of groundwater in terms of levels, movement, recharge, type of aquifers and hydrochemical characteristic, and then develop mathematical models to simulate the groundwater conditions surrounding the dam reservoir.

References

1. Al-Kraeay, N. A., Al-Jubory, A. j., and Al-Qaisy, M. Q., (2016). Geometric Analysis of the Location of Al-Jirnaf Suggested Dam, Al-Shirqat/ North Iraq, Tikrit Journal for Pure Science, Vol. 21, no. 2, pp. 112-135.

2. Haghiabi, A.H., Slamian, S.S., Mohammadzadeh-Habili, J. and Mosavi, S.F., (2013). Derivation of reservoir's area- capacity equations based on the shape factor, IJST, Transactions of Civil Engineering, Iran, Vol. 37,No.C1.

3. Laurence, C., (2007). Effect of landslides on dam and reservoir, Mokihinui Dam, Opus International Consultants Limited, internal technical, Wellington, New Zealand

4. Ministry of water resources, AlRafidain General Company for Dams Design and Construction, (2010). Al-Wind dam Project, Internal report,

5. Saleh, S. A., and Al-Shahry, G. Sh., (2017). Flood Routing of Tigris River in Baiji Station and Makhoul Dam Reservoir under Supposed Operation of the Dam, Tikrit Journal for Pure Science, Vol. 22, no. 1, pp. 115-127.

6. Salih, L. M., (2013), Makhoul dam reservoir, Hydrologic and geometric study to select the optimum levels, unpublished Ph. D. thesis, Department of Geography. College of education for Humanities, Tikrit University.

7. Sawunyama, T., Senzanje A., Mhizha, A., (2005). Estimation of small reservoir storage capacities Limpopo river basin using geographical information system and remote sensed surface areas, M.Sc. thesis, department of civil engineering, faculty of engineering, university of Zimbabwe.

التحليل الجيومتري لخزان سد الوند في شمال شرق العراق باستخدام نماذج الارتفاعات الرقمية ونظام التحليل المكاني

صبار عبدالله صالح ، اكتفاء طه عبد القادر ، امين موفق إبراهيم ، هدى مزهر حسين

قسم علوم الارض التطبيقية ، كلية العلوم ، جامعة تكريت ، تكريت ، العراق

الملخص

ناقشت هذه الورقة موضوع حيوي واستراتيجي، وهو التحليل الهندسي لخزان سد الوند في ديالى، اذ استخدمت نظم التحليل المكاني لاشتقاق موقع خزان سد الوند من نموذج الارتفاعات الرقمية، عند 26 منسوب منتخب ابتداءا من 195 وحتى 219.5 متر فوق مستوى سطح البحر، وبفاصلة قدرها متر واحد، واعتمدت المعايير الجيومترية لاستخلاص قيم العناصر الجيومترية السالبة الاساسية ممثلة بحجم الخزين (السالب) (NV) (Negative volume) والمساحة المستوية السالبة (NPA) (Negative Planner Area) والمساحة المستوية(المبتلة) (NSA) (Negative Surface Area) والمحيط وعمق العمود المائي ومعامل الشكل للخزان، وكذلك الحال بالنسبة للعناصر الجيومترية الموجبة الحجمية (PV) (Positive Volume) والمساحية (PPA) (Planner Area Positive) و (PSA) (Positive Surface Area) للجزر المحصورة داخل محيط الخزان، العناصر المذكورة أساسية في الدراسات الجيومترية، إذ على أساسها تصمم سياقات تشغيل الخزان، كالتخزين والاطلاق من بوابات السد في ظروف التشغيل المختلفة، وهي التي تحدد التغيرات التي ستحدث على استخدامات الأرض بعد البدء بالتخزين عند كل منسوب، وكذلك تغاير مكاشف التكوينات الجيولوجية التي ستتعرض للغمر مع تغاير المنسوب، وبناء عليه تم تحديد المنسوب الذي يضمن تشغيلا آمنا للخزان بما يلبي ابعاد الخطر عن السد، واقل هدر في استخدامات الأرض واقل مساحة مغمورة، واقل هدر في الخزين المائي، كما تم وضع العلاقة الرياضية بين مساحة وسعة الخزان لتستخدم مستقبلا لاستتباع الفيضانات في الخزانات، وتحديد المساحة السطحية للخزان كذلك التنبؤ بسعة الخزان عند أي مستوى للماء وكذلك تصنيف الخزان.

اظهر التحليل الحالي أن المنسوب التشغيلي الاقصى الامن هو (215) م فوق مستوى سطح البحر الذي يبلغ عنده حجم الخزين الى (54308822) م^3، في حين اشارت الدراسة الاولية للسد التي اجريت بالطرق التقليدية للمسح ان حجم الخزين عند نفس المنسوب هو (37820000) م^3.

صدرت نماذج الارتفاعات الرقمية لكل منسوب منتخب على شكل صور رقمية بمقياس رسم موحد لغرض المقارنة البصرية بين امتدادات واشكال الخزان عند المناسيب المختلفة، ان هذا التحليل مفيد لادراة السد في وضع السياسة التشغيلية للخزان.